

REMARKS/ARGUMENTS

Minor changes are made to this specification. Claims 1-3, 5-6, 8-10, 13, 21-23 are amended. New claims 24-26 are added. Claims 1-3, 5-6, 8-10, 13-14, and 17-26 are pending in the application of which claims 14 and 17-20 are withdrawn from consideration. Reexamination and reconsideration of the application, as amended, are respectfully requested.

No new matter is added. Support for new claim 24 can be found, for example, at Figures 1(a), 1(b) and 2 and the accompanying text. Support for new claim 25 can be found for example at Figures 3(a), 3(b) and the accompanying text. Support for new claim 26 can be found, for example, at paras. [00286] , [00286] and Figure 1(b) of the published application, Patent Publ. 2007/0295381.

Claim Rejections—35 U.S.C. § 112

Claims 21 and 22 stand rejected under 35 U.S.C. § 112, second paragraph as allegedly being indefinite for failing to distinctly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Office contends that there is insufficient antecedent basis in claims 21 and 22 for the recitations of the first bus bar electrode, the second bus bar electrode and the third bus bar electrode. Claims 1, 21 and 22 have been amended.

Applicant respectfully submits that the amended claims fully comply with 35 U.S.C. § 112. Specifically, applicant notes that claims 21 and/or 22 require that the “at least three bus bar electrodes” comprise “a first front surface bus bar electrode” (claim 21 and claim 22) “a second front surface bus bar electrode” (claim 22), and “ a third front surface bus bar electrode” (claim 22). As such, there is proper antecedent basis for each claim limitation.

Claims Rejections—35 U.S.C. § 103

Claims 1-3, 13, 21, and 23 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Hanoka et al. (U.S. Patent No. 5,476,553). Claims 1-3, 5-6, 8-10, 13 and 21-23 stand rejected as allegedly being unpatentable over Fujii et al. (US 2003/0178057). Claims 1-3, 5-6, 8-10, 13, 21-23 are amended. Applicant respectfully submit that the amended claims patentably distinguish over the cited art.

Claim 1, as amended, is as follows:

A group of solar cell elements comprising:
a plurality of solar cell elements and at least three wiring members for electrically interconnecting adjacent solar cell elements, each solar cell element comprising:
a substrate comprising a front surface and a rear surface; and
a front surface electrode on the front surface; and
a rear surface electrode on the rear surface; and
wherein the front surface electrode comprises at least three front surface bus bar electrodes and a plurality of finger electrodes;
wherein at least one of the plurality of finger electrodes is connected to two or more of the at least three front surface bus bar electrodes,
wherein the rear surface electrode comprises at least three rear surface bus bar electrodes,
wherein the at least three wiring members electrically interconnect the at least three front surface bus bar electrodes of a first adjacent solar cell element to the at least three rear surface bus bar electrodes of a second adjacent solar cell element, and
wherein each of the at least three front surface bus bar electrodes has a width of not less than 0.5 mm and not more than 2 mm, and each of the finger electrodes has a width of not less than 0.05 mm and not more than 0.1 mm.

Applicant respectfully submits that the combined references cannot render the present invention obvious at least because a group of solar cell element having a “front surface electrode [that] comprises at least three front surface bus bar electrodes and a plurality of finger electrodes” “wherein each of the at least three front surface bus bar electrodes has a width of not less than 0.5 mm and not more than 2 mm, and each of the finger electrodes has a width of not less than 0.05 mm and not more than 0.1 mm” would not have been obvious to a person of ordinary skill in the art at the time the invention was made.

Regarding Fujii, the Office admits that “Fujii is silent as to the type of surface electrode.” (Office Action, at p. 6.) Regarding Hanoka et al., the office cites Hanoka et al. Fig. 2 as disclosing “the surface electrode is generally in the form of a grid comprising a plurality of bus bars...” (Office Action, at p. 6). However, the office admits Fig. 2 of Hanoka only shows a solar cell element having two bus bar electrodes and does not “explicitly” disclose three bus bars. (Office Action, p.3) Applicant has carefully reviewed Hanoka et al. and agrees that nothing in Figure 2 or in the accompanying description describes as solar cell having a “front surface electrode [that] comprises at least three front surface bus bar electrodes and a plurality of finger

electrodes” as required by amended claim 1. The two bus bar electrode design is explicitly described as the “conventional solar cell 20 of a kind utilized in making modules...” (Hanoka, col. 6, lines 8-10)

Nonetheless, the Office argues that Hanoka et al., render the claims unpatentable based, in part, on Hanoka et al., col. 1, lines 47-56, which states as follows:

The contact on the front surface of the cell is generally in the form of a grid, comprising an array of narrow fingers and at least one elongate bus (also hereinafter called a "bus bar") that intersects the fingers. The width and number of the fingers and busses are selected so that the area of the front surface exposed to solar radiation is maximized. Further, to improve the conversion efficiency of the cell, an AR coating as described overlies and is bonded to those areas of the front surface of the cell that are not covered by the front contact.

The Office argues that one of ordinary skill, based on Hanoka's disclosure, would have optimized by routine experimentation the number of bus bars to arrive at a construction having a “front surface electrode [that] comprises at least three front surface bus bar electrodes and a plurality of finger electrodes” . Office Action, at p. 4.

Applicant respectfully disagrees. First, as applicant has noted, the “conventional configuration” of the solar cell element as described by Hanoka in Fig. 2 comprises a two front surface bus bar electrode not a “front surface electrode [that] comprises at least three front surface bus bar electrodes and a plurality of finger electrodes” as required by claim 1. Further, it is noted that Hanoka teaches in the background section that “[t]he width and number of the fingers and busses are selected so that the area of the front surface exposed to solar radiation is maximized” and presumably the conventional element of Hanoka et al. Figure 2 has been optimized accordingly. Nowhere in Hanoka et al. is there any disclosure that maximizing “the front surface exposed to solar radiation” by controlling the widths and numbers of finger electrodes and bus bars, as taught by Hanoka et al., result in an element having 3 or more bus bar electrodes. Nor has the Office cited any teaching an element in which maximizing “the front surface exposed to solar radiation” results in a solar cell element having 3 or more front surface bus bars.

Moreover, one aspect of the present invention is the finding that a solar cell element having a “front surface electrode [that] comprises at least three front surface bus bar electrodes and a plurality of finger electrodes” has unexpected positive effects on a group of solar cell elements or a module comprised of the individual elements. As described at para. [0045], U.S. Patent Publ. 2007/0295381 (hereinafter, the ‘381 Publ.):

“...while in the case of two bus bar electrodes, when the widths of the finger electrodes are narrowed for preventing light energy loss at the light receiving surfaces of the solar cell elements, the fill factor FF tends to deteriorate due to the series resistance component in the finger electrodes, providing three bus bar electrodes allows the lengths of the finger electrodes to be shortened, so that deterioration of the fill factor FF due to the series resistance component of the finger electrodes can be suppressed. A solar cell module with high output characteristics and high efficiency can therefore be obtained.”

Attached as Exhibit 1 is a collection of data that compares (1) the conversion efficiency (Eff[%]) and output characteristics (Pmax[W]) of individual solar cell elements having 2 front surface bus bar electrodes against individual solar cell elements having 3 front surface bus bar electrodes; and (2) the conversion efficiency (Eff[%]) and output characteristics (Pmax[W]) of solar modules comprised of elements having 2 front surface bus bar electrodes to solar cell modules comprised of elements having 3 front surface bus bar electrodes. As can be seen from Exhibit 1, individual solar cell elements having 2 front surface bus bar electrodes have a **higher** the conversion efficiency (Eff[%] =16.986) and output characteristics (Pmax[W]=4.134) than individual solar cell elements having 3 front surface bus bar electrodes (Eff[%] =16.875, Pmax[W]=4.107). Conversely, solar cell modules (that is a group of solar cell elements) made of elements having 2 front surface bus bar electrodes have a **lower** conversion efficiency (Eff[%] =15.214) and output characteristics (Pmax[W]=3.702) than do solar cell modules of elements having 3 front surface bus bar electrodes (Eff[%] =15.525, Pmax[W]=3.778). This leads to the unexpected result that a higher efficiency module can be made of solar cell elements having 3 front surface bus bar electrodes each of which are individually less efficient than solar cell elements which have 2 front surface bus bar electrodes.

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Applicant respectfully submits that nothing in any of the references cited teaches or suggests the relationship between the number of front surface bus bar electrodes and conversion efficiency and output characteristics of the resulting solar module. In the outstanding action, the Office stated, "As such, without showing unexpected results, the claimed three bus bar electrodes cannot be considered critical." Applicant respectfully submits that the data showing a higher efficiency higher output module comprised of 3 bus bar elements that are individually less efficient than the two bus bar elements evidences the unexpected results and criticality of the presently claimed invention.

As such, Applicant respectfully submits that the invention of amended claim 1 patentably distinguishes over the prior art and allowance of claim 1 is respectfully requested. Claims 2-3, 5-6, 8-10, 13 and 21-25 depend from claim 1 and are patentable for at least the same reasons as claim 1.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (310) 595-3107 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 07-1896.

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Respectfully submitted,

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